

Appl. No.
Filed

: Unknown
: Herewith

REMARKS

These changes are being made to bring the subject application into better conformance with U.S. practice, to claim the benefit of previously filed international applications, and to more distinctly claim what the Applicant regards as the invention. No new matter is being introduced. Entrance of this amendment is respectfully requested. Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

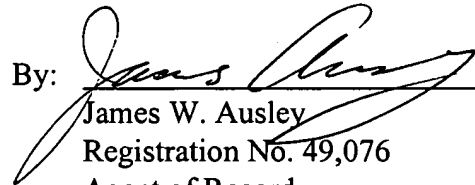
Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated:

12/21/01

By:



James W. Ausley
Registration No. 49,076
Agent of Record
620 Newport Center Drive
Sixteenth Floor
Newport Beach, CA 92660
(909) 781-9231

AMEND

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Attached is a version with markigns to show changes. Insertions are shown **bolded** and deletions are bracketed.

202050-ET102007

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE ABSTRACT:

Abstract of the Disclosure

A tool adapted for changing the direction of drilling during drilling. The drilling equipment used in the drilling includes a drill string, a bent sub, a drill motor, and a drill bit. The tool is positioned between the drill string and the bent sub, includes housing elements connected to one another, and has a passage for drilling fluid. The tool can be activated for rotation of the bent sub so that the direction of drilling is changed in an infinitely variable manner. The tool includes a valve adapted for choking the passage so that the tool can be activated for rotation, a piston adapted for providing the rotation after passage has been choked, and sets of cooperating guides adapted for forced guiding of the rotation. The guides can be formed by twisted splines formed in the wall of the passage and in the wall of the opposite piston.

[The invention relates to a device by a tool (1) adapted for changing the direction of drilling during drilling. The drilling equipment used in the drilling preferably comprised a drill string such as coiled tubing, a bent sub, drilling motor and drill bit. The tool (1) is positioned between the drill string and the bent sub, comprises housing elements (2-5) connected to one another, and has a passage for , i.a., fluid such as drilling fluid. The tool can be activated for rotation of the bent sub, so that the direction of drilling is changed. The object to the invention is to provide a tool, whereby the rotation of the bent sub can take place in an infinitely variable manner. This is realized by means of means (18,20-24,26,27) positioned in the passage of the tool (1), and comprising a valve (20-24) adapted for choking the passage , so that the tool (1) can be activated for rotation, a piston (18) adapted for providing the rotation after the passage has been choked, and sets of co-operating guides (26,27) adapted for forced guiding of the rotation. The guides (26,27) can be formed by twisted splines formed in the wall of the passage and in the wall of the piston (18) opposite.]

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IN THE SPECIFICATION:

Please amend the specification as follows:

[DEVICE BY] TOOL FOR CHANGING THE DRILLING DIRECTION WHILE DRILLING

Related Applications

This application claims the benefit of the Norwegian application 19993138 filed June 24, 1999 and the international application PCT/NO00/00213 filed June 21, 2000.

Background of the Invention

Field of the Invention

The invention relates to [device by a tool], adapted for changing the drilling direction while drilling with drilling equipment, which preferably comprises a drill string, such as coiled tubing, a bent sub, drilling motor and drill bit.

Description of the Related Art

During directional drilling of a formation in the ground, e.g. in horizontal drilling of a well, it is common to use drilling equipment, which comprises a drill string, bent sub and drill bit. The drill string may be formed of coiled tubing, and the drill bit may be hydraulically driven by the fluid circulating in the drill string. The drilling direction is changed through rotation of the bent sub, and the rotation is effected by [the] a tool which is positioned between the lower end of the drill string and the bent sub. In known tools the rotation cannot be infinitely variable, but has to be done in invariable angular turns in the range of 15-20 degrees. This means that the drilling direction cannot be changed with the desirable accuracy. Another drawback of known tools is that the admission of the drill bit will have to be reduced to allow rotation of the bent sub. The consequence of this may be that the drill bit loses its grip in the ground formation, so that instead of completing its rotation, the bent sub will return to its initial position. This is a condition which complicates and moreover delays the work of changing the drilling direction.

Summary of the Invention

The main object of the present invention is to provide a [device by a tool], whereby the rotation of the bent sub may be carried out in an infinitely variable manner. Other objects are

that the rotation should take place by full admission of the drill bit, and the rotation should take place at a speed which allows the measuring equipment to provide measurement results which are in accordance with the actual rotation. Thereby the drilling direction could be changed without the drawbacks mentioned above. Moreover, the tool will be somewhat easier to operate and provide greater precision during rotation than what has been normal. This has been realized through the present [device by a tool]adapted for changing the drilling direction during drilling. The drilling equipment used in the drilling, preferably comprises a drill string, such as coiled tubing, a bent sub, drill motor and drill bit. Further the tool is positioned between the drill string and the bent sub, comprises housing elements connected to one another, has a passage for, among other things, fluid such as drilling fluid, and may be activated for rotation of the bent sub, so that the direction of drilling is changed. The particular about the invention is that the tool is provided with means, which are adapted so that the rotation can be infinitely variable. [Said] The means are provided in the through passage of the tool, and comprises a valve arranged to choke the passage, so that the tool can be activated for the rotation, a piston adapted for providing the rotation after the through passage has been choked, and sets of cooperating guides adapted for forced guiding of the rotation. The guides are formed in the wall of the through passage, or in the opposite wall for the piston. Other details of the invention will appear from the dependent Claims and the following part of the specification.

Brief Description of the Drawings

Referring to the appended set of figures, a preferred, but non-limiting embodiment of the invention will be explained,

Detailed Description of the Preferred Embodiment

In Figs. 2-4 the tool has been divided into two sections for reason of exposition, and the reference numerals have been distributed among the figures, so that the reference numerals of one figure refer to the same details in the other figures.

IN THE CLAIMS:

Please amend the Claims as follows:

1. (Amended) A [device by a] tool [(1)] adapted for changing the direction of drilling with drilling equipment [, which preferably comprises] **comprising** a drill string [such as coiled tubing], drill string sub, drilling engine and drill bit, wherein the tool [(1)] is positioned between the drill string and the bent sub **and wherein the tool** comprises housing elements [(2-4)], which are connected to one another, **and wherein the tool** has a passage for [, i.a.,] fluid [such as drilling fluid], and wherein the tool [(1)] is equipped with a hydraulic piston [(18)] having [been provided with] a set of co-operating guides [(26,27)] where the guides [(26,27)] are arranged for by the pistons axial displacement a forced guiding of the rotation of [one of the hosing] **a first housing** element[s (5)] with respect to the other housing elements [(2-4)], and where necessary fluid pressure for moving the piston [(18)] is obtained by choking the [pressurefluid] **fluid** flow through the tool [(1), characterized in that] **and wherein a** [the] lower intermediate housing element [(4)] and **a** [the] lower housing element [(5)] are connected by a one direction rotatable connection [(8)] such as a roller bearing, adapted for only allowing rotation in one direction and opposes any rotation in the other direction at any rotational position].

2. (Amended) [A device according to] **The tool of Claim 1**, [characterized in that one] **wherein a first** set of the guides [(26)] is formed in the wall of the passage, and [one] **a second** set of the guides [(27)] is formed in the wall of the piston [(18)] opposite.

3. (Amended) [A device according to one or any of the previous claims, characterized in that said] **The tool of Claim 2**, **wherein the** set of guides [(26,27)] for the forced guiding of the rotation [are formed by] **comprise** twisted splines, [one] **a first** set of splines [(26)] being formed in a circumferential portion of **an** [the] upper intermediate housing element [(3)], whereas [one] **a second** set of splines is formed in a circumferential portion of the piston [(18)].

4. (Amended) [A device according to one or any of the previous claims, characterized in that the former] **The tool of Claim 3**, **wherein the first** set of splines [(26)] extends in a region at the upper end of the lower housing element [(5)], whereas the [latter] **second** set of splines [(27)] extends essentially in the longitudinal direction of the piston [(18)].

5. (Amended) [A device according to one or any of the previous claims, characterized in that] **The tool of Claim 1**, **further comprising a** [the] valve [comprises]

comprising a valve seat [(20)] formed at the upper end of a bore adapted to provide a passage through the piston [(18)] , a valve body [(21)] and a valve mechanism [(22,23,24)] adapted for choking and opening the valve by increase and relief, respectively, of the fluid pressure in the tool [(1)].

6. (Amended) [A device according to one or any of the previous claims, characterized in that] **The tool of Claim 5, wherein** the valve mechanism is formed by an upper and a lower valve body part [(22,23)] adapted for displacement along the valve body [(21)], so that the lower valve body part [(23)] can choke or open the valve, and a valve body spring [(24)], wherein the upper valve body part [(22)] will displace the lower valve body part [(23)] to choke the valve when the pressure of the fluid is increased, and the valve body part spring [(24)] will displace the lower valve body part [(23)] in the opposite direction to open the valve by relief of the pressure of the fluid.

7. (Amended) [A device according to one or any of the previous claims, characterized in that] **The tool of Claim 5, wherein** the piston [(18)] is adapted to be displaced by the fluid supplied to the tool [(1)] when the valve has been choked, or be displaced in the opposite direction by a piston spring [(25)], positioned in an upper annular space [(17)], formed in the passage of the tool [(1)], after the valve has opened.

8. (Amended) [A device according to one or any of the previous claims, characterized in that said] **The tool of Claim 7, wherein** the piston [(18)] is sleeve-shaped, positioned between an upper shoulder [(14)] formed in the passage of the tool [(1)], and a shoulder element [(31)] located in the upper annular space [(17)] and formed with a length which enables the piston [(18)] to extend from the upper shoulder [(14)] into the upper annular space [(17)] located in [the] an extension above a lower shoulder [(15)] formed at the lower end of the upper annular space [(17)].

9. (Amended) [A device according to one or any of the previous claims, characterized in that] **The tool of Claim 1, wherein** the piston [(18)] and the upper end of the lower housing element [(5)] are displaceably and rotatably connected,

10. (Amended) [A device according to one or any of the preceding claims, characterized in that] **The tool of Claim 9, wherein** the displaceable and rotatable connection is formed by a ratchet mechanism [(28)] formed with catch elements [(30)] locking against, or running freely across, guides [(29)] formed at the upper end of the lower housing elements [(5)],

so that the lower housing element [(5)] is subjected to rotation when the piston [(18)] is displaced down the passage of the tool [(1)], or is without rotation when the piston [(18)] is displaced back through the passage of the tool [(1)].

11. (Amended) [A device according to one or any of the preceding claims, characterized in that] **The tool of Claim 7, wherein** the lower housing element [(5)] has a lower annular space [(36)] arranged thereto, for fluid which is displaced from the upper annular space [(17)], **and wherein** [that] the annular spaces [(17,36)] communicate by means of channels [(38,39)] extending between the annular spaces [(17,36)] **respectively**, and **wherein** [that] the flow of displaced fluid can be controlled by a check valve [(40) and a choke valve [(41)] placed in the respective channels [(38,39)].

12. (Amended) [A device according to one or any of the preceding claims, characterized in that] **The tool of Claim 11, wherein** the lower annular space [(36)] has a displaceable annular space body [(37)] arranged thereto.

13. (Amended) [A device according to one or any of the preceding claims, characterized in that] **The tool of Claim 6, wherein** the valve body [(21)] and the **upper** valve body part [(22)] are formed with bores, so that [,for example] a cable can be drawn through the passage of the tool [(1)].

14. (New) The tool of Claim 1, wherein the one direction rotatable connection comprises a roller bearing adapted for rotation in one direction and opposing rotation in the opposite direction in any rotational position.

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